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News Release

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Release	Contact	Phone	Address
June 1, 2005	Stephen Gingerich	808-587-2411	677 Ala Moana Blvd
	Email	Fax	Suite 415
	sbginger@usgs.gov	808-587-2401	Honolulu, HI 96813

New Three-Dimensional Ground-Water Model of Pearl Harbor Aquifer

A recent U.S. Geological Survey study has produced a three-dimensional numerical ground-water flow model of the Pearl Harbor Aquifer System on Oahu, the most heavily used aquifer in the State of Hawaii. Using the model, researchers are able to display graphically the shrinkage of Oahu's freshwater supply due to one hundred years of ground-water withdrawal in the Pearl Harbor area.

The model approximately reproduces 100 years of historical field observations for water level and salt concentration at a number of locations where data are available during the period 1880 to 1980. During this period, the simulation shows that the potable water body shrinks significantly due to the rise, landward movement, and thickening of the transition zone between freshwater and saltwater. The readjustment of the freshwater–saltwater transition zone underlying the potable freshwater lens takes a long time following changes in pumping, irrigation, or recharge in the aquifer system. It takes about 50 years for the transition zone to move 90% of the distance to its new steady position. Thus, parts of the ground-water system may still be readjusting to ground-water withdrawals made 50 years ago.

'This type of ground-water flow model is the state of the art in hydrologic analysis of our ground-water systems" says report co-author Stephen Gingerich, a research hydrologist in the USGS's Pacific Islands Water Science Center. This type of tool is very useful for studying how our freshwater supply was affected by historic pumping and rainfall. But of greater value is the ability to use models to manage and plan for future changes in the freshwater system due to factors such as increased ground-water demand or prolonged drought. Water managers around the world are increasingly using this type of complex tool to insure that water supplies are adequate for future needs.

USGS research funds were used to create this preliminary model to demonstrate the usefulness of the new USGS modeling capabilities. Researchers at the USGS are currently working on enhancing the Pearl Harbor model in a cooperative study with the Honolulu Board of Water Supply. In addition, similar models are under development for central Maui and northern Guam.

The numerical model is based on the US Geological Survey's three-dimensional solute transport (3D SUTRA) computer code. Using several new tools for pre- and post-processing of model input and results have allowed easy model construction and unprecedented visualization of the freshwater lens and underlying transition zone in Hawaii's most developed aquifer. Three-dimensional graphical animations of the changes in the freshwater-lens system over 100 years were produced from the model results.

The paper "Three-dimensional variable-density flow simulation of a coastal aquifer in southern Oahu, Hawaii, USA" by Stephen B. Gingerich and Clifford I. Voss was published in Hydrogeology Journal and a link to the journal site and the animations are available on the internet at USGS's Pacific Islands Water Science Center web page (http://hi.water.usgs.gov/). Paper copies of the report can be obtained by contacting the U.S. Geological Survey at 587-2400.

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